International Comprehensive Ocean-Atmospheric Data Set (ICOADS)

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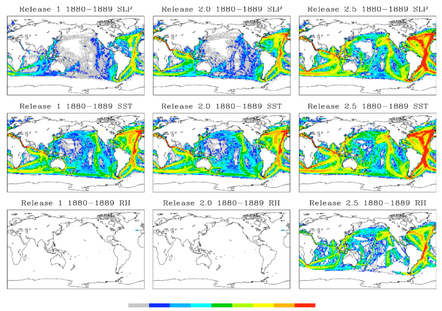
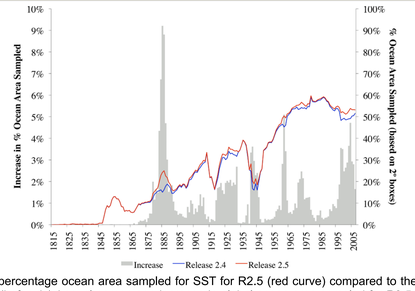
Evolving Spatial Coverage



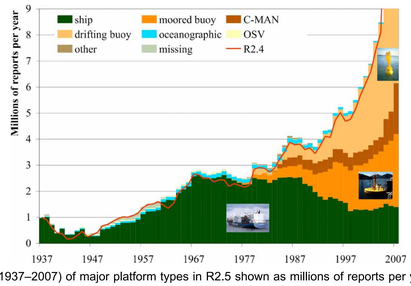
Decadal (1880–1889) totals of sea level pressure (SLP) observations (upper) illustrating data additions between Releases 1 (completed in 1985), 2.0 (2002), and 2.5 (2009) (R2.5). The colors show the number of observations in a 2° box per decade. Grey indicates 1–10; dark blue indicates 11–20; …; orange indicates 641–1280; red indicates 1281 or more. (Middle and Lower) As for (upper) except for sea surface temperature (SST) and relative humidity (RH).

Evolving Temporal Coverage



(Right axis) Annual percentage ocean area sampled for SST for R2.5 (red curve) compared to the previous Release (R2.4) (blue curve). (Left axis) Annual percentage increase in global ocean area sampled for R2.5, compared to R2.4 (bars).

Evolving Platform Mixture



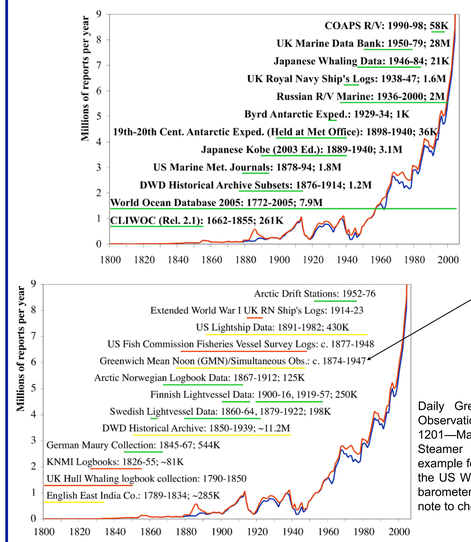
Annual distribution (1937–2007) of major platform types in R2.5 shown as millions of reports per year. For clarity the vertical scale is truncated at 9M; years 2005–07 have 13M, 15M, and 16M total reports (not visible) in R2.5, respectively. The red line curve contrasts the R2.4 annual counts. Ships (mainly VOS plus some R/Vs), buoys and oceanographic are self explanatory, Ocean (permanent) Station Vessel = OSV, Coastal–Marine-Automated Network = C-MAN, ocean drilling rigs/platforms and other small entities = other, and unidentified platform types = missing. (Figure adapted from Woodruff et al. (2008); ship photo courtesy of www.ShipPhotos.co.uk).

Project Background

As the result of a US project starting in 1981, available global surface marine data from the late 17th century to date have been assembled, quality controlled, and made widely available to the international research community in products of the Comprehensive Ocean-Atmosphere Data Set (COADS). A new name, International COADS (ICOADS), was agreed in 2002 to recognize the multinational input to the blended observational database and other benefits gained from extensive international collaboration, while maintaining continuity of identity with COADS, which has been widely used and referenced.

ICOADS has grown from a US-centric effort between NOAA—its ESRL Physical Science Division (PSD) and National Climatic Data Center (NCDC)—and the National Center for Atmospheric Research (NCAR), to an expanded US and international partnership. The NOAA portion of ICOADS is partially funded by the NOAA Climate Program Office (CPO).

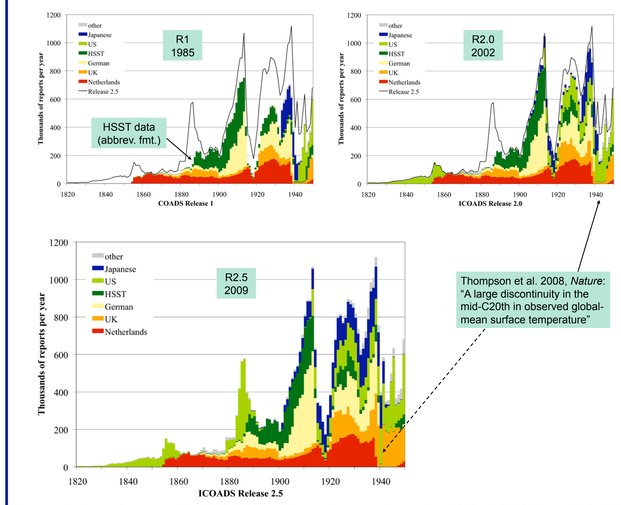
Blended/Candidate Data Source



Daily Greenwich Mean Noon (GMN) Observations (US Weather Bureau Form 1201—Marine, 1910) from the German Steamer *Prinz Waldmar*, 1911. This example form includes stamps posted by the US Weather Bureau after receipt for barometer type and corrections, and a note to check GMN time.

(Top) Major historical data sources added to R2.5 (Woodruff et al. 2010a). Horizontal green lines illustrate the time range of the original data sources. The annual numbers of reports are plotted as curves, blue for the previous R2.4, and red for R2.5. For clarity the vertical scale is truncated at 9M; years 2005-07 have 13M, 15M, and 16M total reports (not visible) in R2.5, respectively. Data coverage prior to 1800 is very sparse. (Bottom) Similar to (Top), the time periods of candidate historical data to be blended into ICOADS are spanned by horizontal colored lines: green candidates are fully digitized but require format translation, yellow are partially digitized, and red are in the planning stages for digitization. Each dataset name is appended with the date range and approximate number of reports (if known) (from Wilkinson et al. 2010).

Evolving National Data Mixture



Thousands of reports per year for 1820-1949 available in Releases 1 (issued in 1985), 2.0 (2002), and 2.5 (2009), stratified by national sources, and from the Historical SST Data Project (HSST). The annual numbers of reports in R2.5 are also plotted as a curve for R1 and R2.0 to highlight the later gains. Thompson et al. (2008) identified a large discontinuity c. 1945 arising from abrupt national data mixture changes based on R2.0 data.

Recent ICOADS and Related Publications

- Brohan, P., R. Allan, J.E. Freeman, A.M. Waple, D. Wheeler, C. Wilkinson, and S. Woodruff, 2009: Marine observations of old weather. *Bull. Amer. Meteor. Soc.*, **90**, 219-230.
- Charpentier, E., D.E. Harrison, J.R. Keeley, E. Kent, M. Mietus, N. Rayner, M. Rutherford, V. Swail, and S, Woodruff, 2008: Third JCOMM Workshop on Advances in Marine Climatology (CLIMAR-III). *MeteoWorld*, December 2008.
- Kent, E., S. Woodruff, N. Rayner, T. Arbetter, C. Folland, F. Koek, D. Parker, R. Reynolds, R. Saunders, V. Smolyanitsky, S. Worley, and T. Yoshida, 2007: Advances in the use of historical marine climate data (Second International Workshop on Advances in the Use of Historical Marine Climate Data). *Bull. Amer. Meteor. Soc.*, **88**, 559-564.
- Thompson, D. W. J., J. J. Kennedy, J. M. Wallace, and P. D. Jones. A large discontinuity in the mid-twentieth century in observed global-mean surface temperature. *Nature*, **453**, 646-649 (2008).
- Wilkinson, C., S.D. Woodruff, P. Brohan, S. Claesson, E. Freeman, F. Koek, S.J. Lubker, C. Marzin, and D. Wheeler, 2010: RECovery of Logbooks And International Marine Data: The RECLAIM Project. *Int. J. Climatol.* (in press).
- Woodruff, S.D., H.F. Diaz, E.C. Kent, R.W. Reynolds, and S.J. Worley, 2008: The evolving SST record from ICOADS. In *Climate Variability and Extremes during the Past 100 Years* (S. Broennimann, J. Luterbacher, T. Ewen, H.F. Diaz, R.S. Stolarski, and U. Neu, Eds.), Advances in Global Change Research, Vol. 33, Springer, 65-83.
- Woodruff, S.D., S.J. Worley, S.J. Lubker, Z. Ji, J.E. Freeman, D.I. Berry, P. Brohan, E.C. Kent, R.W. Reynolds, S.R. Smith, and C. Wilkinson, 2010a: ICOADS Release 2.5: Extensions and Enhancements to the Surface Marine Meteorological Archive. *Int. J. Climatol.* (in press).
- Woodruff, S.D., N. Scott, D.I. Berry, M.A. Bourassa, E. Charpentier, S. Gulev, H. Haar, E.C. Kent, R.W. Reynolds, G. Rosenhagen, M. Rutherford, V. Swail, S.J. Worley, H.-M. Zhang, R. Zöllner, 2010b: Surface In situ Datasets for Marine Climatological Applications. In *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 2)*, Venice, Italy, 21-25 September 2009, Hall, J., Harrison D.E. & Stammer, D., Eds., ESA Publication WPP-306 (in press).
- Worley S.J., S.D. Woodruff, S.J. Lubker, Z. Ji, J.E. Freeman, E.C. Kent, P. Brohan, D.I. Berry, S.R. Smith, C. Wilkinson, and R.W. Reynolds, 2010: The Role of ICOADS in the Sustained Ocean Observing System. In *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 2)*, Venice, Italy, 21-25 September 2009, Hall, J., Harrison D.E. & Stammer, D., Eds., ESA Publication WPP-306 (in press).